

**Macroeconomic Theory
Comprehensive Exam 2014**

May 16, 2014

You have three and a half hours for this exam. Neither books nor class notes are permitted. No electronic devices are permitted.

The exam consists of 3 pages. There are 180 points in total. Each short question accounts for 15 points and each long question for 60 points. Answer all questions.

Please read the whole exam before starting. Wherever you do maths, explain briefly what you are doing.

Short Questions (15 points each, answer all four questions)

1. The standard approach to measure total factor productivity uses data on factor income shares, α , output, capital and labor growth together with the assumption that factor markets are competitive to reach the following measure $\hat{A} = \hat{Y} - \alpha\hat{K} + (1 - \alpha)\hat{L}$. Since we can also write production following the income approach $Y = rK + wL$ it should be possible to derive a dual measure of total factor productivity based on the growth rates of prices. Derive such a measure.
2. Consider a simple one-period model where one unit of employment produces one unit of output, $Y = N$. Firms sell output at a price P and the labor market is competitive. Households supply L units of labor inelastically and enter this economy with M units of money. They care about consumption and real money balances at the end of the period (the money supply at the end of the period divided by the expected price level tomorrow, this is simply a shortcut to capture some concerns for the future in a one-period model). As a result we can write their preferences as, $\ln(C) + \ln\left(\frac{M'}{P^e}\right)$. The government finances the nominal value of its expenditures, PG , issuing additional money, $M' - M$, or collecting lump-sum taxes, T . Let's assume the government chooses money and expenditure freely and uses lump-sum taxes to balance the budget.
 - (a) Assuming prices are flexible, derive and discuss the effects of government policy (both fiscal and monetary policy).
 - (b) Assuming prices are fixed above the full employment level, derive and discuss the effects of government policy.
3. Use a simple model to show how a tax on wealth affects saving behavior.
4. "If the return to saving exceeds the growth rate of output, wealth will grow faster than wages, and capitalists' share of income will keep growing." Comment.

Long question 1 (60 points)

Consider an industry with N identical and competitive firms. Profits at time t of the i -th firm, neglecting any costs of acquiring and installing capital, are given by,

$$\pi(K_t) K_{it}$$

with $\pi'(\cdot) < 0$.

Firms face costs of acquiring and installing/uninstalling capital given by the quadratic adjustment cost function (where the price of capital has been normalized to 1),

$$C(I_i) = I_i + \frac{h}{2} I_i^2$$

Assume that the firm invests so as to maximize the present value of its profits, where it is free to borrow/lend as much as it desires at a fixed interest rate, r . Capital evolves according to the following law of motion,

$$\dot{K}_i = I_i$$

1. Write down the inter-temporal profit function of the firm.
2. Denoting the co-state variable by q , derive and interpret the optimality conditions. Derive the firm's investment demand.
3. If you integrate the Euler equation with respect to time and you impose the transversality condition you reach the following expression:

$$q(t) = \int_t^{\infty} \pi(K_s) e^{-r(s-t)} ds \quad (1)$$

Interpret this result. If you were to construct an empirical measure of Tobin's q , what type of data and assumptions would you need?

4. Draw the phase diagram and assess the stability of the resulting steady state (graphically and analytically).
5. Compare the effects of an anticipated permanent increase in $\pi(K_t)$ with those of a unanticipated one. Draw the time paths of the stock market value of the industry and profits per unit of capital. Use equation (1) to compare the initial response of the stock market value of the industry under both scenarios. In which sense is the anticipated shock different from an investment bubble?
6. During the great recession, the interest rate spreads for corporate paper increased substantially (for instance, by a factor of 4 for AAA bonds). Use this model to explore the real effects of such a shock. If monetary policy can affect the real interest rate, is there any role for the Central Bank in the face of such a shock?
7. Explain the differences between the dynamic behavior of the steady state characterized in 4. and one derived in the absence of adjustment costs. In this case, assume the price of capital is given by p_K rather than normalized to 1.

8. If you were to conduct a serious quantitative exercise using this model, you will need to specify certain functional forms and calibrate the model. Specify the functional form for $\pi(K_t)$. Discuss carefully different data moments you could use in your calibration.

Long question 2 (60 points)

An agent lives for two periods. He/she values consumption in each period with a CRRA utility function $u(c) = c^{1-\sigma}/(1-\sigma)$, with $\sigma > 0$, and values utility in both periods equally. In period 1, his/her income is y . In period 2, his/her income is $(1+\delta)y$ with probability p and $(1-\delta)y$ with probability $1-p$, where $p = 1/2$ and $\delta > 0$. The agent can save by purchasing a bond that pays no return. Denote savings by a' .

1. Write down the agent's problem.
2. Derive a condition for optimal behavior.
3. Show formally that the saving rate $s \equiv a'/y$ is independent of y . Explain which feature of the problem drives this result.
4. Show formally, using all assumptions made, that the saving rate s is strictly positive. Explain which feature of the problem drives this results.
5. Show formally how the saving rate reacts to a reduction in p . Give an economic interpretation of your finding.
6. Show formally how the saving rate reacts to an increase in δ . Give an economic interpretation of your finding.

Now suppose that this economy consists of many individuals with identical preferences and income processes. The shocks to their incomes are independent. They can trade a bond, which pays a return r , which is determined in equilibrium.

7. Define equilibrium of this economy.
8. What statement can you make about the equilibrium interest rate r ? Draw an appropriate graph and explain.